
National Health Statistics Reports

Number 133 ■ November 15, 2019

Emergency Department Visits for Injuries Sustained During Sports and Recreational Activities by Patients Aged 5–24 Years, 2010–2016

by Pinyao Rui, M.P.H., Jill J. Ashman, Ph.D., and Akintunde Akinseye, M.S.P.H.

Abstract

Objectives—This report describes emergency department (ED) visits made by patients aged 5–24 years for injuries sustained during sports and recreational activities, the treatments provided at these visits, and variation by activity, patient age, and patient sex.

Methods—Data are from the 2010–2016 National Hospital Ambulatory Medical Care Survey. Sports injuries were defined by the *International Classification of Diseases, Ninth Edition, Clinical Modification* and *10th Edition, Clinical Modification* (ICD–9–CM and ICD–10–CM) external cause-of-injury codes, supplemented by manual review of narrative text fields from ED medical records. Sample weights were applied to each case to provide national estimates of ED visits for injuries sustained during sports and recreational activities.

Results—During 2010–2016, approximately 2.7 million annual ED visits for sports injuries were made by patients aged 5–24 years. The top five most frequent activities that caused ED visits for sports injuries were football (14.1%), basketball (12.5%), pedal cycling (9.9%), soccer (7.1%), and ice or roller skating or skateboarding (6.9%). Visits caused by playing football and basketball accounted for a higher percentage of visits by males than females (20.2% compared with 2.2%, and 14.3% compared with 8.9%, respectively), whereas visits caused by gymnastics and cheerleading accounted for a higher percentage of visits by females (11.8% compared with 2.1%). Visits for injuries to the upper extremities decreased with increasing age (37.1% for those aged 5–9 to 27.4% for those aged 20–24), whereas visits for injuries to the lower extremities increased with increasing age (16.2% for those aged 5–9 to 41.0% for those aged 20–24). Approximately three in four ED visits for sports injuries included an imaging service ordered or provided. Computed tomography scans were ordered or provided at a higher percentage of visits for patients aged 15–19 years compared with all other age groups. Analgesics, including opioids and nonopioids, were given or prescribed at 63.9% of ED visits, and this percentage increased with age (51.2% for those aged 5–9 to 74.4% for those aged 20–24).

Keywords: National Hospital Ambulatory Medical Care Survey • injury • young adults • children

Introduction

Injuries sustained during sports or recreational activities (hereafter referred to as sports injuries) have received more widespread attention in recent years due in part to interest in injury monitoring and prevention (1) and rising rates of traumatic brain injury (TBI)-related emergency department (ED) visits (2). Although exposure to sports offers many health benefits, participating in sports also increases risk of injury (1). An estimated annual 5.6 million sports injuries affected children and young adults in 2011–2014 (3). Sports injuries are a common type of injury presenting to hospital EDs and are most common among older children and young adults (4,5).

Much of the previous research has used data from population-based surveys to estimate the incidence of sports injuries (1,6). Furthermore, research on ED visits for sports injuries has mainly focused on a specific type of sport (7,8) or the body region affected (9–12). To the authors' knowledge, estimates of treatments administered in the ED for sports injuries have not been updated since 1998 (13). The National Hospital Ambulatory Medical Care Survey (NHAMCS), a national



U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Center for Health Statistics



survey of nonfederal, general, and short-stay hospitals, provides nationally representative data on ED visits that include information on characteristics of the injury and treatment provided. Information on each ED visit in NHAMCS is abstracted directly from the patient's medical record and includes narrative text describing the sports injury in the patient's own words.

Since 1992, narrative text has been used to code injuries in NHAMCS using external cause-of-injury codes from the *International Classification of Diseases* (ICD) (13). External cause-of-injury codes do not capture the full range of sports injuries because certain detailed information on the nature of the injury does not have corresponding codes. For example, some sports injuries are assigned to the broad classification of accidental falls, but not all accidental falls are related to sports injuries. Due to this limitation, and following existing literature (13–15), the definition of sports injuries used in this report uses external cause-of-injury codes supplemented with a manual review of the narrative text, providing a comprehensive source of information on sports injuries. Consequently, results presented in this report differ somewhat than if sports injuries had been defined using external cause-of-injury codes exclusively.

This report provides descriptive, national estimates of ED visits for sports injuries, with a focus on the type of sport or recreational activity that caused the injury, injury diagnosis, body region affected, and diagnostic services and treatments administered at the ED visit. Because significant variation occurs in the number of ED visits for sports injuries by youth age and sex, analyses are further stratified and compared across age groups (5–9, 10–14, 15–19, and 20–24 years) and sex (males and females). Analyses are restricted to children, adolescents, and young adults because most sports injury visits occur among this age group, and for consistency with previous sports injury research that also analyzed NHAMCS data (13).

Methods

Data source

Data are from NHAMCS, which is conducted by the National Center for Health Statistics (NCHS). NHAMCS is an annual probability sample survey of U.S. hospital EDs and outpatient departments that uses a four-stage probability sampling procedure, which includes sampling nonfederal, short-stay, and general hospitals within geographic areas and ED visits within hospitals. The NHAMCS documentation describes the plan, operation, and survey design of NHAMCS (16). Analyses in this report used the Emergency Department component of NHAMCS.

In 2010 and 2011, hospital staff and U.S. Census Bureau field representatives completed paper patient record forms for a systematic random sample of patient visits occurring during a randomly assigned, 4-week reporting period (16). In 2012, NHAMCS implemented computer-assisted data collection, which replaced the traditional pen-and-paper method. During 2010–2011, response rates for NHAMCS ranged from 92.4% to 95.1%. For 2012–2016, response rates ranged from 73.4% to 83.5%. To assess potential bias in combining data before and after this change in the method of data collection, the weighted percentage of ED visits for sports injuries by patients aged 5–24 years during 2010–2011 were compared with such percentages for 2012–2016, by both age and sex. The percent distributions for 2010–2011 and 2012–2016 were similar for each age group ($p = 0.2$) and for males and females ($p = 0.8$), suggesting that the results were consistent over time.

Because ED visits, not persons, are the unit of measurement for this report, the prevalence of sports injuries in the U.S. population cannot be determined with these data. NHAMCS visit data include patient demographic characteristics as well as visit information obtained from the medical record, including medical diagnosis, disposition, primary expected source of payment, diagnostic and therapeutic services ordered or provided, procedures provided, drugs given in the ED or prescribed at discharge, and cause of

injury. The survey, which was first fielded in 1992, has always collected narrative text on cause-of-injury information. Trained medical coders assigned text entries with *International Classification of Diseases, Ninth Edition, Clinical Modification* (ICD–9–CM) external cause-of-injury codes (E-codes) through 2015 (17), and *International Classification of Diseases, 10th Edition, Clinical Modification* (ICD–10–CM) external cause-of-morbidity codes for 2016 data (18).

Selection of sports and recreational activity injury visits

Sports and recreational activity injury visits were initially identified using three variables containing E-codes from ICD–9–CM and, beginning with 2016 data, external cause-of-morbidity codes from ICD–10–CM ([Technical Notes Table](#)). Consistent with previous studies (13–15), narrative text fields were reviewed for cause of injury to identify visits caused by sports and recreational activities not captured by ICD–9–CM or ICD–10–CM classification schemes. Using predetermined keywords ([List](#)), the narrative text fields describing the injury were queried, and the resulting cases were reviewed. The queries included variations of words used, such as “exercising” and “exercise,” or “cycling” and “cycle.” Only the root word capturing the essence of the sport or recreational activity is listed. (See the [Technical Notes](#) for more information about case assignment after manual review of the narrative text, and subsequent assessment of cases captured using ICD codes compared with those captured from manual review.) For confidentiality reasons, the narrative text variable is only available in the in-house data files (available in the Research Data Center: <https://www.cdc.gov/rdc/index.htm>) and is not included in public-use files.

During 2010–2016, a total of 3,360 unweighted ED visit records by patients aged 5–24 years were identified as sports injuries by using ICD codes. An additional 1,182 unweighted records not captured by codes were flagged for review using the keyword search

of narrative text fields. Of these 1,182 records, 392 unweighted visit records by patients aged 5–24 years were designated as sports injuries after manual review (Figure). The remaining records identified with the keyword search were classified as non-sports injuries ($N = 790$). A total of 3,752 unweighted records (19,024,000 weighted) were identified as being sports injuries for 2010–2016 using both codes and the cause-of-injury narrative text variable.

Selection of characteristics

The causes of sports injuries were grouped into activity categories consistent with a previous study (3). Diagnoses and affected body region of injury were grouped according to the Barell body region by nature of injury diagnosis matrix (19). Weighted frequencies of diagnostic and screening services, procedures, and medications

administered were obtained to determine the most common treatments provided at ED visits for sports injuries. Definitions for each of the selected visit and treatment variables in this report are in the Technical Notes.

Statistical analyses

This report presents results combining data for 2010–2016 to enable more detailed subgroup analyses. Estimates of the weighted number of visits are based on 7-year averages. To provide national estimates of ED utilization, sample weights were applied to each case. More information about NHAMCS methodology to derive sample weights is available (16). Estimates of sampling error were made using a Taylor series approximation, which takes the complex sampling design into account. All analyses were conducted using SAS version 9.4 (SAS Institute,

Cary, N.C.) and SAS-callable SUDAAN version 11.0 (RTI International, Research Triangle Park, N.C.). Differences in the distribution of selected variables presented are based on chi-squared tests ($p < 0.05$). If a difference was statistically significant, additional pairwise tests were performed. Statements of difference in paired estimates are based on two-tailed t tests with statistical significance at the $p < 0.05$ level. Linear regression was used to assess linear trends by age. All proportion estimates presented meet NCHS guidelines for presentation of proportions (20).

Results

During 2010–2016, the estimated annual average of the number of visits to the ED for sports injuries by patients aged 5–24 years was 2.7 million.

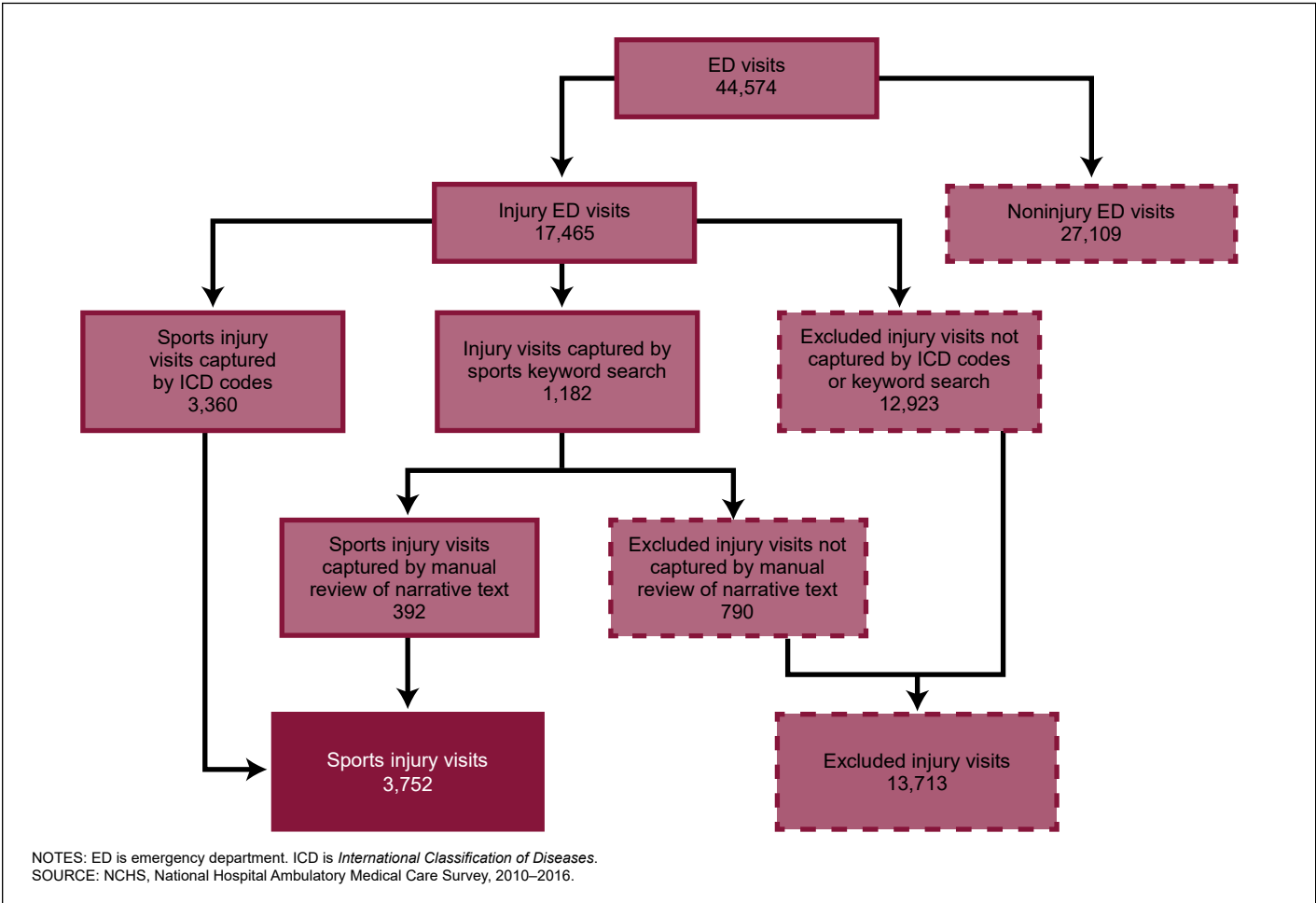


Figure. Selection of emergency department visits made by patients aged 5–24 years for sports and recreational activity injuries: United States, 2010–2016

Types of activities that caused the sports injuries

For 2010–2016, the top five most frequent activities that caused ED visits for sports injuries by patients aged 5–24 years were football (14.1%), basketball (12.5%), pedal cycling (9.9%), soccer (7.1%), and ice or roller skating or skateboarding (6.9%). Variation was observed by age and sex in the types of activities causing ED visits for sports injuries ([Table 1](#)).

The top five most frequent activities causing ED visits for sports injuries among patients aged 5–9 were playground (23.1%), pedal cycling (13.8%), gymnastics or cheerleading (9.3%), running or jogging (8.4%), and other or unspecified activities (7.8%). Among patients aged 10–14, the top five most frequent activities were football (19.9%), basketball (13.0%), pedal cycling (10.1%), soccer (7.4%), and baseball or softball (6.2%). Among patients aged 15–19, the top five most frequent activities causing ED visits for sports injuries were basketball (16.6%), football (16.2%), soccer (9.3%), pedal cycling (7.3%), and ice or roller skating or skateboarding and baseball or softball (both at 5.9%). Among patients aged 20–24, the top five most frequent activities causing ED visits for sports injuries were basketball (15.4%), ice or roller skating or skateboarding (12.8%), other or unspecified activities (9.2%), pedal cycling (8.8%), and soccer (7.2%).

The top five most frequent activities causing ED visits for sports injuries among male patients aged 5–24 were football (20.2%), basketball (14.3%), pedal cycling (10.3%), soccer (6.8%), and ice or roller skating or skateboarding (6.7%). Among female patients, the top five most frequent activities causing ED visits for sports injuries were gymnastics or cheerleading (11.8%), playground (9.2%), pedal cycling (9.1%), basketball (8.9%), and other or unspecified activities (8.8%).

Diagnoses at ED visits for sports injuries

Sprains and strains or dislocations (28.1%) accounted for the largest percentage of ED visits by patients aged

5–24 years for sports injuries, followed by other or unspecified injuries (22.6%), fractures (18.0%), contusions and superficial injuries (16.1%), open wounds (10.5%), and internal injuries (4.7%) ([Table 2](#)).

Sprains and strains or dislocations were diagnosed at a higher percentage of visits for sports injuries by patients aged 10–24 (29.8% for age group 10–14; 33.1% for 15–19; and 35.8% for 20–24) compared with patients aged 5–9 (12.7%). The reverse pattern was seen for open wounds, where an open wound was diagnosed at a higher percentage of visits for sports injuries by patients aged 5–9 (19.9%) compared with older patients (6.7% for age group 10–14; 8.9% for 15–19; and 10.1% for 20–24). Visits with diagnosed fractures decreased with age (from 25.7% for age group 5–9 to 13.6% for 20–24). An internal injury was diagnosed at a higher percentage of visits for sports injuries by patients aged 15–19 (7.5%) than all other age groups. For sex-stratified estimates, the distribution of diagnoses at ED visits for sports injuries was similar for males and females.

Affected body region at ED visits for sports injuries

Two body regions (upper and lower extremities) accounted for a majority of all ED visits for sports injuries by patients aged 5–24 years (62.6%), followed by injuries affecting the head and neck (23.0%) ([Table 2](#)).

Injuries affecting the head and neck were found at a higher percentage of visits for sports injuries made by younger patients aged 5–9 (33.8%) compared with visits by older patients (17.8% for age group 10–14; 25.1% for 15–19; and 15.6% for 20–24). Visits for injuries to upper extremities decreased with age (from 37.1% for age group 5–9 to 27.4% for 20–24). Conversely, visits for injuries to lower extremities increased with age (from 16.2% for age group 5–9 to 41.0% for 20–24). Injuries to lower extremities were found at a higher percentage of visits for sports injuries made by females compared with males (35.5% compared with 27.8%).

Treatments given at ED visits for sports injuries

Use of diagnostic and screening tests at visits for sports injuries varied by age, but not sex. Overall, diagnostic and screening tests were ordered or provided at a higher percentage of visits for sports injuries by patients aged 10–14 (81.4%), 15–19 (82.2%), and 20–24 (78.9%) compared with younger patients aged 5–9 (67.8%) ([Table 3](#)). Imaging tests were ordered or provided at 75.5% of visits for sports injuries, with a majority composed of x-rays (67.0%), followed by computed tomography (CT) scans (11.8%). A CT scan performed on the head was ordered or provided at 8.7% of visits, which was higher than the percentage of CT scans performed on other regions of the body (4.2%). X-ray imaging was ordered or provided at a higher percentage of visits for sports injuries by patients aged 10–24. CT scans were ordered or provided at a higher percentage of visits for sports injuries by those aged 15–19 (16.2%) compared with all other age groups. Overall, use of procedures at visits for sports injuries did not vary by age or sex. However, variation by age was observed for specific procedures. Suturing or staples were ordered or provided at 13.6% of visits for sports injuries by younger patients aged 5–9, which was higher than visits by older patients (4.8% for age group 10–14; 8.0% for 15–19; and 8.9% for 20–24). Intravenous (IV) fluids were ordered or provided at a higher percentage of visits for sports injuries by patients aged 15–19 (8.3%) compared with patients aged 5–14 (4.0%).

The number of medications given in the ED or prescribed at ED discharge at visits for sports injuries varied by age but not sex. Visits with two or more medications given or prescribed increased with increasing age (from 30.2% for those aged 5–9 to 49.9% for those aged 20–24). Analgesic medications were given or prescribed at a majority of visits for sports injuries (63.9%), with a higher percentage composed of nonopioid (41.4%) than opioid (22.5%) analgesics. Opioid analgesics were given or prescribed at 12.8% of visits for sports injuries made by patients aged 5–9; this percentage increased to almost one-half

of ED visits for sports injuries (46.2%) by patients aged 20–24. Almost one-half (47.4%) of visits for sports injuries made by patients aged 10–14 included nonopioid analgesics, higher than the percentages for patients aged 5–9 (38.4%) and 20–24 (28.2%).

Opioid analgesics were given or prescribed at a higher percentage of visits for sports injuries made by males (24.0%) compared with females (19.5%).

Summary

During 2010–2016, an estimated annual average of 2.7 million ED visits in the United States were made by patients aged 5–24 years with a sport or recreational activity injury, representing 21.2% of all injury visits made by patients in this age group. Most ED visits for sports injuries were made by patients aged 10–19 (66.5%) and by males (66.2%).

Estimates of ED visits for sports injuries from this analysis are similar to an older analysis using NHAMCS data (13), which reported 2.6 million annual sports injury visits made by patients aged 5–24 in 1997–1998. Similarly, another study using the National Electronic Injury Surveillance System (NEISS) reported an annual 2.7 million sports- and recreation-related ED visits made by patients aged 19 and under during 2001–2009 (21). These findings suggest that youth ED visits for sports injuries have stayed relatively stable in recent years. The highest number of ED visits for sports injuries was seen in the 10–19 age group, which is consistent with other reports (13,15).

This analysis found that the top two activities causing ED visits for sports injuries were football and basketball, which is consistent with a study assessing pediatric sports- and recreation-related ED visits using NEISS 2001–2013 data (5). In the current study, gymnastics or cheerleading accounted for 147,000 annual visits compared with approximately 51,000 annual visits in the 2001–2013 NEISS (5). Ice or roller skating or skateboarding (mostly skateboarding) was an activity frequently causing ED visits for sports injuries by patients under age 15. A study focused on skateboarding-related ED visits using

data for 1990–2008 reported a significant increasing trend in the annual rate of skateboarding injuries during 1994–2008, with the largest percent change observed among children aged 11–14 (22). Among patients aged 5–19, the population studied in the above report, the estimated annual number of skateboarding-related ED visits for 2010–2016 was 89,000 (data not shown), which is higher than the annual 65,000 skateboarding-related visits from the earlier time period of 1990–2008 reported in the same study (22).

Pedal cycling appeared as a top five activity that caused ED visits for sports injuries in all age groups examined, with the highest number of annual visits observed among patients aged 10–14. This finding is similar to a NEISS study that assessed nonfatal bicycle injuries presenting to EDs during 2001–2008, where patients aged 10–14 had the highest bicycle-related ED visit rate (23).

The top diagnoses associated with sports injuries were sprains and strains or dislocations, followed by fractures and contusions or superficial injuries. This is consistent with previous sports injury reports assessing injuries presenting to EDs and in the general population (3,13,15).

Variation by patient sex in the body region affected by the sports injury was driven by a higher percentage of female visits for sports injuries affecting the lower extremity compared with male visits. Existing research suggests females are more susceptible to knee injuries such as an anterior cruciate ligament (ACL) tears, a common sports injury (24). Injuries affecting the head and neck were seen at a higher percentage of visits for sports injuries made by those aged 5–9 (33.8%) compared with older age groups. This was consistent with a previous study (5). Among patients aged 5–9, the top two activities causing the ED visits were playground and pedal cycling, which appeared in the top three activities associated with the number of pediatric TBI-related ED visits as reported in another study (21). About one-quarter of visits for sports injuries made by patients aged 15–19 were caused by an injury to the head and neck region, the second highest percentage for this injury after visits by patients aged 5–9. Studies have

reported an increase in sports-related TBI and concussion visits in recent years (12,21,25), and approximately one-half of all concussion ED visits made by patients aged 14–19 are related to sports (25,26). Visits by patients aged 15–19 were more likely to be related to internal injuries compared with all other age groups. Injuries affecting the head and neck region accounted for 94.4% of internal injury visits, 88.5% of which included a primary diagnosis of concussion (data not shown).

Imaging helps determine diagnosis and prognosis of the sports injury (27). The high percentage of imaging tests characteristic of ED visits for sports injuries suggests they incur high medical costs (28). A study using data from 1997 through 1998 (13) found that sports-related ED injury visits were more likely to require diagnostic and therapeutic services compared with non-sports-related injury visits. X-rays were ordered or provided at a majority of visits for sports injuries, which was higher than the percentage of CT scans ordered or provided. CT scans are typically ordered if the patient presents with a potentially more severe injury such as a cervical spine injury, skull fracture, suspicion of intracranial bleeding, or a loss of consciousness greater than 30 seconds (29). CT scans were more likely to be ordered or provided at ED visits for sports injuries made by patients aged 15–19 (16.2%), which is consistent with the higher rate of visits for internal injuries made by patients in this age group.

Nonopioids, such as nonsteroidal anti-inflammatory agents (NSAIDs), were given or prescribed most frequently for sports injury visits. NSAIDs are the first-line treatment for sprains and strains (30), which, as shown in this report, are a common diagnosis at ED visits for sports injuries. Opioids were given or prescribed in almost one-quarter of visits for sports injuries, with patients aged 20–24 receiving opioids at almost one-half of their visits for sports injuries. Opioid misuse and abuse is the fastest-growing drug problem among adolescents in the United States (31). Data from the National Survey on Drug Use and Health indicate that older youth aged 18–25 are more likely to misuse prescription opioid

pain relievers than any other group of people in the United States (32).

This analysis has limitations that should be taken into consideration when interpreting results. Due to small sample sizes, estimates for some variables were not reliable and could not be reported. Further, certain detailed subgroups, such as those for diagnoses and body regions, had to be combined to create broader groupings to enable reliable estimation. Because NHAMCS does not explicitly collect specific information on sports or recreational activities, the definition of sports and recreational activities relied heavily on data processing and manual review that drew from multiple variables (e.g., cause-of-injury codes and narrative cause-of-injury text variable), which could have resulted in over- or underestimation of the sports injury ED rate. For instance, to capture running and jogging cases in this analysis, a systematic rule for designating nonspecific entries of “running” or “jogging” as sports-related injuries may have resulted in overestimation of running or jogging for sport if the nonspecific entry actually referred to running for a reason unrelated to sports or recreational activities, such as “running up the stairs, tripped, and fell.” Finally, NHAMCS only includes injuries recorded in the ED and does not include patients who sought care in other settings or who did not seek care; thus, while the estimates in this report are an underestimate of all health care utilization for sports injuries, the purpose of this report was to make estimates of visits to the ED.

The findings from this report contribute to the literature on sports injury surveillance, which could be used to inform strategies for new prevention interventions aimed at reducing injury rates. In addition, this report bolsters very limited research on treatments administered at visits for sports injuries, providing new information that can be used to monitor improvements to the quality and value of care and serve as a benchmark for future studies.

References

- Conn JM, Annett JL, Gilchrist J. Sports and recreation related injury episodes in the US population, 1997–99. *Inj Prev* 9(2):117–23. 2003.
- Centers for Disease Control and Prevention. Surveillance report of traumatic brain injury-related emergency department visits, hospitalizations, and deaths—United States, 2014. Atlanta, GA. 2019.
- Sheu Y, Chen LH, Hedegaard H. Sports- and recreation-related injury episodes in the United States, 2011–2014. National Health Statistics Reports; no 99. Hyattsville, MD: National Center for Health Statistics. 2016.
- Weiss AJ, Elixhauser A. Sports-related emergency department visits and hospital inpatient stays, 2013. HCUP Statistical Brief, no 207. Rockville, MD: Agency for Healthcare Research and Quality. 2016.
- Bayt DR, Bell TM. Trends in paediatric sports-related injuries presenting to US emergency departments, 2001–2013. *Inj Prev* 22(5):361–4. 2016.
- Bijur PE, Trumble A, Harel Y, Overpeck MD, Jones D, Scheidt PC. Sports and recreation injuries in US children and adolescents. *Arch Pediatr Adolesc Med* 149(9):1009–16. 1995.
- Sachs CJ. Epidemiology of cheerleading injuries presenting to NEISS hospitals. *J Trauma Acute Care Surg* 72(4):1116. 2012.
- Esquivel AO, Bruder A, Ratkowiak K, Lemos SE. Soccer-related injuries in children and adults aged 5 to 49 years in US emergency departments from 2000 to 2012. *Sports Health* 7(4):366–70. 2015.
- Golan E, Kang KK, Culbertson M, Choueka J. The epidemiology of finger dislocations presenting for emergency care within the United States. *Hand* 11(2):192–6. 2016.
- Shah NS, Buzas D, Zinberg EM. Epidemiologic dynamics contributing to pediatric wrist fractures in the United States. *Hand (N Y)* 10(2):266–71. 2015.
- Sharma VK, Rango J, Connaughton AJ, Lombardo DJ, Sabesan VJ. The current state of head and neck injuries in extreme sports. *Orthop J Sports Med* 3(1):2325967114564358. 2015.
- Sarmiento K, Thomas KE, Daugherty J, Waltzman D, Haarbauer-Krupa JK, Peterson AB, et al. Emergency department visits for sports- and recreation-related traumatic brain injuries among children—United States, 2010–2016. *MMWR Morb Mortal Wkly Rep* 68(10):237–42. 2019.
- Burt CW, Overpeck MD. Emergency visits for sports-related injuries. *Ann Emerg Med* 37(3):301–8. 2001.
- Tenan MS. Quantifying emergency department visits from sport and recreation: Focus on the lower extremity and knee, 1997–2009. *J Athl Train* 51(4):309–16. 2016.
- Simon TD, Bublitz C, Hambidge SJ. Emergency department visits among pediatric patients for sports-related injury: Basic epidemiology and impact of race/ethnicity and insurance status. *Pediatr Emerg Care* 22(5):309–15. 2006.
- National Center for Health Statistics. 2016 NHAMCS micro-data file documentation. Hyattsville, MD. 2018. Available from: https://ftp.cdc.gov/pub/Health_Statistics/NCHS/Dataset_Documentation/NHAMCS/doc16_ed.pdf.
- Centers for Disease Control and Prevention, Centers for Medicare & Medicaid Services. International classification of diseases, ninth revision, clinical modification. Sixth ed. DHHS Pub No. (PHS) 11–1260. 2011. Available from: <https://www.cdc.gov/nchs/icd/icd9cm.htm>.
- National Center for Health Statistics. International classification of diseases, 10th revision, clinical modification. Available from: <https://www.cdc.gov/nchs/icd/icd10cm.htm>.
- Barell V, Aharonson-Daniel L, Fingerhut LA, Mackenzie EJ, Ziv A, Boyko V, et al. An introduction to the Barell body region by nature of injury diagnosis matrix. *Inj Prev* 8(2):91–6. 2002.
- Parker JD, Talih M, Malec DJ, Beresovsky V, Carroll M, Gonzalez Jr JF, et al. National Center for Health Statistics data presentation standards for proportions. National Center for Health Statistics. *Vital Health Stat* 2(175). 2017.
- Centers for Disease Control and Prevention. Nonfatal traumatic brain injuries related to sports and recreation activities among persons aged ≤ 19 years—United States, 2001–2009. *MMWR Morb Mortal Wkly Rep* 60(39):1337–42. 2011.
- McKenzie LB, Fletcher E, Nelson NG, Roberts KJ, Klein EG. Epidemiology of skateboarding-related injuries sustained by children and adolescents 5–19 years of age and treated in US emergency departments: 1990 through 2008. *Inj Epidemiol* 3(1):10. 2016.
- Chen WS, Dunn RY, Chen AJ, Linakis JG. Epidemiology of nonfatal bicycle injuries presenting to United States emergency departments, 2001–2008. *Acad Emerg Med* 20(6):570–5. 2013.
- Stanley LE, Kerr ZY, Dompier TP, Padua DA. Sex differences in the incidence of anterior cruciate ligament, medial collateral ligament, and meniscal injuries in collegiate and high school sports:

- 2009–2010 through 2013–2014. *Am J Sports Med* 44(6):1565–72. 2016.
25. Bakhos LL, Lockhart GR, Myers R, Linakis JG. Emergency department visits for concussion in young child athletes. *Pediatrics* 126(3):e550–6. 2010.
26. Gaw CE, Zonfrillo MR. Emergency department visits for head trauma in the United States. *BMC Emerg Med* 16:5. 2016.
27. Forster BB. Sports imaging: Radiologists as team leaders in care of the athlete. *Radiology* 278(2):313–4. 2016.
28. Hendee WR, Becker GJ, Borgstede JP, Bosma J, Casarella WJ, Erickson BA, et al. Addressing overutilization in medical imaging. *Radiology* 257(1):240–5. 2010.
29. Merkel DL, Molony Jr JT. Medical sports injuries in the youth athlete: Emergency management. *Int J Sports Phys Ther* 7(2):242–51. 2012.
30. Braund R. Should NSAIDs be routinely used in the treatment of sprains and strains? *Pharm J* 276:655–6. 2006.
31. Groenewald CB, Rabbitts JA, Gebert JT, Palermo TM. Trends in opioid prescriptions among children and adolescents in the United States: A nationally representative study from 1996 to 2012. *Pain* 157(5):1021–7. 2016.
32. Substance Abuse and Mental Health Services Administration. Key substance use and mental health indicators in the United States: Results from the 2018 National Survey on Drug Use and Health. HHS Publication No. PEP19-5068, NSDUH Series H-54. Rockville, MD: Center for Behavioral Health Statistics and Quality. 2019. Available from: <https://store.samhsa.gov/system/files/nsduhffr2018.pdf>.
33. Overpeck MD, Pickett W, King MA, Garner M, Marshall L, Trifiletti LB, et al. Application of the ICECI classification of external cause of injury to the WHO health behavior in school-aged children survey. In: *Proceedings of the International Collaborative Effort on Injury Statistics, Vol III*. DHHS publication No. PHS-00-1026-0. Hyattsville, MD: National Center for Health Statistics. 2000.

Table 1. Annual averages and percentages of emergency department visits for sports and recreational activity injuries, by activity type, age, and sex: United States, 2010–2016

Characteristic	Total	Age group (years)				Sex	
		5–9	10–14	15–19	20–24	Male	Female
Number of visits (standard error)							
All sports and recreational activity visits	2,717,672 (132,654)	557,150 (39,818)	980,078 (58,761)	827,357 (56,868)	353,088 (27,176)	1,797,904 (100,111)	919,768 (53,549)
Percent (standard error)							
Activity type ¹							
Football	14.1 (1.1)	5.5 (1.6)	19.9 (1.8)	16.2 (1.7)	6.9 (1.4)	20.2 (1.7)	2.2 (0.5)
Basketball ²	12.5 (0.8)	3.6 (0.9)	13.0 (1.3)	16.6 (1.8)	15.4 (2.2)	14.3 (1.2)	8.9 (1.0)
Pedal cycling ³	9.9 (0.8)	13.8 (1.6)	10.1 (1.3)	7.3 (1.3)	8.8 (1.5)	10.3 (1.0)	9.1 (1.1)
Soccer ²	7.1 (0.6)	3.1 (0.8)	7.4 (1.1)	9.3 (1.5)	7.2 (1.5)	6.8 (0.8)	7.7 (1.1)
Ice or roller skating or skateboarding	6.9 (0.6)	6.1 (1.1)	6.1 (0.8)	5.9 (0.9)	12.8 (3.3)	6.7 (0.7)	7.5 (1.0)
Playground ^{3,4}	6.3 (0.6)	23.1 (2.2)	3.5 (0.7)	0.7 (0.3)	*	4.8 (0.6)	9.2 (1.1)
Other or unspecified ⁵	6.2 (0.6)	7.8 (1.4)	5.2 (0.9)	5.1 (0.9)	9.2 (1.9)	4.9 (0.5)	8.8 (1.2)
Running or jogging	5.5 (0.5)	8.4 (2.3)	5.3 (0.8)	4.5 (0.8)	4.2 (1.2)	5.1 (0.6)	6.4 (0.9)
Gymnastics or cheerleading ³	5.4 (0.5)	9.3 (2.0)	5.3 (0.8)	4.1 (0.7)	*	2.1 (0.4)	11.8 (1.4)
Baseball or softball	5.1 (0.5)	3.5 (1.0)	6.2 (0.9)	5.9 (1.0)	2.7 (0.7)	4.9 (0.6)	5.4 (0.9)
Recreational sport ⁶	3.4 (0.5)	4.8 (1.2)	2.6 (0.7)	2.6 (0.7)	5.4 (1.5)	3.7 (0.6)	2.9 (0.5)
Aerobics or exercising or weight training ²	3.3 (0.5)	1.0 (0.4)	3.2 (0.8)	4.3 (1.2)	*	3.5 (0.8)	3.0 (0.6)
Other team sport ⁷	3.2 (0.5)	1.0 (0.5)	3.1 (0.6)	4.9 (1.3)	3.0 (1.1)	2.9 (0.6)	3.8 (0.8)
Water sport	3.0 (0.4)	4.5 (1.3)	2.1 (0.5)	2.7 (0.6)	4.0 (1.1)	2.3 (0.5)	4.4 (0.8)
Combative sport ²	2.8 (0.4)	1.0 (0.6)	2.8 (0.6)	3.9 (0.8)	3.2 (0.9)	3.5 (0.5)	1.4 (0.4)
Snow sport ²	2.6 (0.5)	1.4 (0.6)	1.9 (0.5)	2.9 (0.8)	6.1 (1.7)	2.4 (0.4)	3.1 (0.9)
Other individual sport ⁸	2.6 (0.5)	2.3 (0.9)	2.3 (0.6)	3.0 (1.1)	2.8 (1.0)	1.6 (0.3)	4.5 (1.2)

* Estimate does not meet NCHS standards of reliability.

¹Difference in distribution is statistically significant between characteristic and age and characteristic and sex ($p < 0.05$).

²Significant increasing linear trend by age.

³Significant decreasing linear trend by age.

⁴Includes playground equipment injuries and other injuries sustained at the playground.

⁵Includes school-related and other unspecified activities.

⁶Includes tennis, racquetball, badminton, and other racquet sports, as well as golf, bowling, fishing, hunting, hiking, mountain climbing, and other leisure sports.

⁷Includes volleyball, rugby, hockey, lacrosse, cricket, and other team sports.

⁸Includes all other sport and recreation categories, such as horseback riding, riding an all-terrain vehicle, playing catch, and other non-team activities.

NOTE: Numbers may not add to totals due to rounding.

SOURCE: NCHS, National Hospital Ambulatory Medical Care Survey, 2010–2016.

Table 2. Percent distribution of selected diagnoses and affected body regions at sports and recreational activity injury visits, by age and sex: United States, 2010–2016

Characteristic	Total	Age group (years)				Sex	
		5–9	10–14	15–19	20–24	Male	Female
Number of visits (standard error)							
All sports and recreational activity visits . . .	2,717,672 (132,654)	557,150 (39,818)	980,078 (58,761)	827,357 (56,868)	353,088 (27,176)	1,797,904 (100,111)	919,768 (53,549)
Percent (standard error)							
Injury diagnosis ¹							
Sprains and strains or dislocations ^{2,3}	28.1 (1.3)	12.7 (1.7)	29.8 (2.0)	33.1 (2.4)	35.8 (2.8)	26.8 (1.5)	30.5 (1.9)
Other and unspecified	22.6 (1.4)	23.8 (2.7)	20.9 (1.7)	24.1 (2.2)	21.8 (3.3)	22.9 (2.0)	22.0 (1.8)
Fractures ⁴	18.0 (0.9)	25.7 (2.5)	19.8 (1.5)	12.6 (1.3)	13.6 (1.8)	19.0 (1.3)	16.0 (1.3)
Contusions and superficial injuries	16.1 (0.9)	15.2 (1.7)	18.5 (1.5)	13.8 (1.3)	16.3 (2.1)	15.0 (1.1)	18.3 (1.4)
Open wounds ³	10.5 (0.8)	19.9 (2.5)	6.7 (0.9)	8.9 (1.5)	10.1 (1.7)	11.5 (1.0)	8.7 (1.3)
Internal injuries ⁵	4.7 (0.5)	2.8 (0.9)	4.2 (0.8)	7.5 (1.3)	2.4 (0.9)	4.8 (0.6)	4.4 (1.1)
Body region ⁶							
Upper extremity ⁴	32.2 (1.0)	37.1 (2.7)	36.5 (1.8)	25.7 (1.6)	27.4 (2.7)	33.2 (1.3)	30.2 (1.8)
Lower extremity ^{2,7}	30.4 (1.0)	16.2 (2.1)	32.4 (1.9)	33.0 (2.3)	41.0 (3.2)	27.8 (1.3)	35.5 (1.7)
Head and neck ^{3,5}	23.0 (1.0)	33.8 (2.6)	17.8 (1.6)	25.1 (1.8)	15.6 (1.9)	24.1 (1.2)	20.8 (1.8)
Unclassifiable	7.8 (0.6)	6.7 (1.2)	7.2 (0.9)	8.4 (1.5)	10.1 (1.7)	8.2 (0.8)	7.1 (0.9)
Spine, back, and torso	6.6 (0.5)	6.2 (1.4)	6.1 (0.9)	7.8 (1.0)	5.9 (1.3)	6.7 (0.7)	6.4 (0.9)

¹Difference in distribution is statistically significant between characteristic and age ($p < 0.05$).²Significant increasing linear trend by age.³Estimate for the 5–9 age group is significantly different from older age groups ($p < 0.05$).⁴Significant decreasing linear trend by age.⁵Estimate for the 15–19 age group is significantly different from all other age groups ($p < 0.05$).⁶Difference in distribution is statistically significant between characteristic and age and characteristic and sex ($p < 0.05$).⁷Estimate for males is significantly different from females ($p < 0.05$).

NOTE: Numbers may not add to totals due to rounding.

SOURCE: NCHS, National Hospital Ambulatory Medical Care Survey, 2010–2016.

Table 3. Treatments given at sports and recreational activity emergency department visits, by age and sex: United States, 2010–2016

Characteristic	Total	Age group (years)				Sex	
		5–9	10–14	15–19	20–24	Male	Female
Number of visits (standard error)							
All sports and recreational activity visits	2,717,672 (132,654)	557,150 (39,818)	980,078 (58,761)	827,357 (56,868)	353,088 (27,176)	1,797,904 (100,111)	919,768 (53,549)
Number of diagnostic or screening services ordered or provided ¹							
Percent (standard error) ²							
None ³	21.5 (1.0)	32.2 (2.7)	18.6 (1.5)	17.8 (1.6)	21.1 (2.6)	21.4 (1.0)	21.6 (1.9)
1 or more services ⁴	78.5 (1.0)	67.8 (2.7)	81.4 (1.5)	82.2 (1.6)	78.9 (2.6)	78.6 (1.0)	78.4 (1.9)
Common services ordered or provided ¹							
Any imaging ⁴	75.5 (0.9)	63.3 (2.8)	78.9 (1.5)	78.7 (1.6)	77.3 (2.7)	75.9 (1.0)	74.6 (1.8)
X-ray ⁴	67.0 (1.1)	55.6 (2.8)	71.4 (1.8)	67.9 (1.8)	70.5 (2.7)	66.8 (1.3)	67.3 (1.8)
CT scan ⁵	11.8 (0.8)	8.6 (1.7)	10.3 (1.1)	16.2 (1.8)	10.5 (1.9)	12.5 (1.0)	10.2 (1.4)
CT scan (head) ²	8.7 (0.7)	6.7 (1.6)	7.5 (0.9)	11.9 (1.5)	7.8 (1.6)	9.4 (0.9)	7.3 (1.1)
CT scan (other than head) ²	4.2 (0.5)	2.1 (0.7)	3.4 (0.8)	6.0 (1.2)	5.5 (1.5)	4.2 (0.5)	4.2 (1.1)
Number of procedures provided							
None ³	37.9 (1.4)	40.0 (2.7)	40.1 (2.2)	33.7 (1.7)	38.7 (3.2)	37.2 (1.7)	39.3 (2.1)
1 or more procedures	62.1 (1.4)	60.0 (2.7)	59.9 (2.2)	66.3 (1.7)	61.3 (3.2)	62.8 (1.7)	60.7 (2.1)
Common procedures provided							
Cast, splint, or wrap	41.2 (1.2)	36.2 (2.8)	45.3 (2.1)	40.9 (2.4)	38.6 (3.5)	41.0 (1.4)	41.6 (2.1)
Suturing or staples ^{1,4}	8.1 (0.7)	13.6 (2.1)	4.8 (0.7)	8.0 (1.3)	8.9 (1.8)	8.7 (0.9)	6.8 (1.3)
Intravenous fluids ^{1,6}	5.7 (0.5)	4.0 (0.9)	4.0 (0.8)	8.3 (1.4)	6.7 (1.5)	5.5 (0.7)	6.0 (0.9)
Number of medications given or prescribed ¹							
None ^{3,7,8}	25.7 (1.1)	33.3 (2.9)	26.7 (1.7)	23.2 (1.9)	16.7 (2.6)	24.5 (1.2)	27.9 (2.2)
1 medication	40.5 (1.3)	36.4 (2.4)	43.9 (2.0)	42.1 (2.2)	33.4 (3.3)	40.1 (1.6)	41.2 (2.2)
2 or more medications ⁹	33.8 (1.2)	30.2 (2.4)	29.4 (2.0)	34.7 (1.8)	49.9 (3.2)	35.4 (1.5)	30.9 (1.9)
Common medications given or prescribed							
Analgesics ^{1,7,9}	63.9 (1.2)	51.2 (3.0)	65.5 (1.8)	66.0 (2.0)	74.4 (2.9)	64.6 (1.3)	62.4 (2.3)
Opioids ^{9,10}	22.5 (1.0)	12.8 (1.5)	18.1 (1.7)	24.0 (1.6)	46.2 (3.7)	24.0 (1.2)	19.5 (1.5)
Nonopioids ¹	41.4 (1.2)	38.4 (2.6)	47.4 (1.9)	42.0 (2.2)	28.2 (3.7)	40.7 (1.3)	42.9 (2.1)
Antiemetic or antivertigo agents ^{1,9}	7.1 (0.6)	4.0 (0.9)	6.5 (1.1)	8.8 (1.5)	9.7 (2.0)	7.9 (0.8)	5.6 (1.0)
Antiarrhythmic agents ¹	5.4 (0.6)	10.2 (2.0)	3.3 (0.7)	4.4 (0.8)	5.5 (1.4)	5.6 (0.7)	4.9 (1.1)

¹Difference in distribution is statistically significant between characteristic and age ($p < 0.05$).²Percentage exceeds 100.0 because more than one service, procedure, or drug may be reported per visit.³Includes unknown and blank.⁴Estimate for age group 5–9 is significantly different from older age groups ($p < 0.05$).⁵Estimate for age group 15–19 is significantly different from all other age groups ($p < 0.05$).⁶Estimate for age group 15–19 is significantly different from the 5–9 and 10–14 age groups ($p < 0.05$).⁷Estimates are significantly different from all other age groups, except between the 10–14 and 15–19 age groups ($p < 0.05$).⁸Significant decreasing linear trend by age.⁹Significant increasing linear trend by age.¹⁰Difference in distribution is statistically significant between characteristic and age and characteristic and sex ($p < 0.05$).

SOURCE: NCHS, National Hospital Ambulatory Medical Care Survey, 2010–2016.

Technical Notes

Case assignment after manual review

The sports and recreational activity keywords in the following [List](#) were derived from Burt's analyses of emergency department (ED) visits for sports-related injuries using National Hospital Ambulatory Care Survey (NHAMCS) 1997–1998 data (13) and updated with additional keywords obtained from more recent sports injury studies (5,14). Records identified using the keyword search approach were reviewed independently by two reviewers to ensure that they met the definition for sports injuries. Some records identified using the keyword search were ambiguous and had to be handled on a case-by-case basis, using general rules for case designation. For instance, nonspecific entries listing just “running” or “walking” were classified as sports injuries. If additional details revealed useful information (e.g., “running to the bus stop” [not classified as a sports injury]), then those cases were adjudicated accordingly by the two reviewers. Cases in which the injury appeared to have happened at a place not typically used for sport or recreation were deemed non-sports-related (e.g., “wrestling on couch” and “running up the stairs in home”). Further, intentional injuries were excluded if there was no indication of a sporting event or game (e.g., “hit by baseball bat”). The decisions made independently by both reviewers were compared. Independent classification of the narrative text showed a 10.2% inconsistency (Cohen's kappa = 0.9) in the designation of a sports injury based on narrative text cases, with much of this discrepancy due to ambiguous cases. All authors jointly reviewed all remaining discrepant cases, and a final decision was made about whether to include or exclude each case. Overall, 66.8% of all narrative text fields reviewed for visits by patients aged 5–24 years from 2010–2016 were ultimately excluded from the analysis ([Figure](#)).

Assessment of case assignment

Examination of the top 10 *International Classification of Diseases* (ICD) codes for primary cause of injury between cases captured by codes (90.9% of all visits for sports injuries) and those captured after manual review of the cause-of-injury narrative text variable (9.1% of all visits for sports injuries) revealed mostly similarities in the top ICD codes, with slight variations, suggesting that external causes of injury were similar between the visits for sports injuries captured by each of the two methods of case designation. Most of the records that were captured only after manual review and ultimately deemed to be caused by sports or recreational activities included the primary nonspecific *International Classification of Diseases, Ninth Edition, Clinical Modification* (ICD–9–CM) external cause-of-injury codes (E-codes) (for 2010–2015) of 917.9 for “other striking against with or without subsequent fall”; 888.8 for “other fall”; 928.8 for “other and unspecified environmental and accidental causes”; 885.9 for “fall from other slipping, tripping, or stumbling”; and *International Classification of Diseases, 10th Edition, Clinical Modification* (ICD–10–CM) codes (for 2016) of W18.3 for “other and unspecified fall on same level”; W01 for “fall on same level from slipping, tripping and stumbling”; X58 for “exposure to other specified factors”; and W50 for “accidental hit, strike, kick, twist, bite or scratch by another person,” which are not part of the list of sports-related ICD codes ([Table](#)). These cases did not have a sports-related code in the other two cause-of-injury items, which was why they were not initially captured and had to be reviewed based on the manual keyword search. Cases captured by the list of codes may have included the above nonspecific codes in the primary cause of injury field, but they also included a sports-related code in the other two cause-of-injury fields. For 2010–2015, a higher percentage of visits for sports injuries captured by medical coding had a first-listed code of 917 “striking against or struck accidentally by objects or persons” and

927 “overexertion and strenuous and repetitive movements or loads” compared with visits for sports injuries captured after manual review of the literal text (24.3% compared with 14.8% and 12.4% compared with 9.4%, respectively), whereas a higher percentage of visits for sports injuries captured after manual review of the literal text had a first-listed code of 888 “other and unspecified fall” compared with visits for sports injuries captured by codes (21.2% compared with 11.8%). In 2016, a higher percentage of visits for sports injuries captured by ICD–10–CM codes had a first-listed code of X58 “exposure to other specified factors” compared with visits for sports injuries captured after manual review (15.9% compared with 8.3%), whereas a higher percentage of visits for sports injuries captured after manual review had a first-listed code of W50 “accidental hit, strike, kick, twist, bite or scratch by another person” compared with visits for sports injuries captured by codes (8.3% compared with 5.2%).

Further, chi-squared tests were used to examine differences in the demographic distribution of visits for sports injuries captured by ICD codes and those captured after manual review of the narrative fields. The bivariate associations of case designation method (ICD code or manual review) with patient sex (female or male), age group (5–9, 10–14, 15–19, and 20–24 years), and primary expected source of payment (private; Medicaid, Children's Health Insurance Program, or other state-based program; no insurance; and other or blank) were not statistically significant, suggesting that demographic characteristics were similar between the visits for sports injuries captured by each of the two methods of case designation.

Definition of terms

Sports or recreational activity injury (sports injury)—Based on ICD–9–CM E-codes (for 2010–2015) or ICD–10–CM external cause-of-morbidity codes (for 2016) ([Table](#)), and the narrative cause-of-injury text variable, after querying verbatim text with predetermined keywords ([List](#)).

List of terms used to capture cases for manual review of narrative text fields to define sports and recreational activity injuries

Aerobics	Four square	Resistance band
Archery	Frisbee	Roller skates
Arrow	Golf	Rowing
Backpacking	Gym	Rugby
Badminton	Gym class	Run
Ball	Gymnastics	Sailing
Ballet	Handball	Salsa
Baseball	Hike	Scuba
Basketball	Hockey	Shooting
Bat	Horseback	Skate
Bicycle	Hunting	Skateboard
Bike	Ice skating	Skating
Board	Inline skates	Ski
Boarding	Jog	Sled
Bootcamp	Juggling	Snowboard
Bowling	Jump rope	Snowmobile
Boxing	Jumping	Soccer
Bungee	Karate	Softball
Canoe	Kayak	Sports
Catch	Kickball	Squash
Cheerleading	Lacrosse	Surfing
Circuit training	Lifting weights	Swim
Class	Martial arts	Tackle
Climbing	Oar	Tae kwon do
Collided	Obstacle	Tag
Course	Paddle	Tennis
Cricket	Paintball	Terrain
Cycling	Pilates	Toboggan
Dance	Playground	Touch
Dirt biking	Polo	Track
Diving	Practice	Trampoline
Dodgeball	Puck	Treadmill
Drills	Pushed	Tubing
Elliptical	Racing	Volleyball
Exercise	Racket	Water craft
Fencing	Racquet	Weightlift
Field	Racquetball	Wrestling
Fishing	Raft	Yoga
Flag	Rappelling	Zumba
Flip	Recreation	
Football	Refereeing	

Activity type—Based on ICD–9–CM E-codes (for 2010–2015), ICD–10–CM external cause-of-morbidity codes (for 2016), and the narrative cause-of-injury text variable. Each activity type was classified according to the sports module of the *International Classification of External Causes of Injury* (33), which was consistent with previous studies (3,13).

Body regions—The five body region groups were classified based on the Barell body region by nature of injury diagnosis matrix, or simply the Barell matrix (19). The Barell matrix of ICD–9–CM diagnosis codes was used to categorize injury diagnoses by the following four body regions affected: a) head and neck, b) spine, back, and torso, c) upper extremity, and d) lower extremity. For 2016, ICD–10–CM codes were matched to corresponding ICD–9–CM codes and grouped according to the Barell matrix. Spine, back, and torso were combined to increase the reliability of estimates. Unclassifiable by site composed a fifth group to specify diagnoses that affected more than one body region. Cases with a diagnosis code that did not fall in the injury code range as defined by ICD–9–CM or ICD–10–CM (i.e., noninjury codes) were assigned to a body region affected and then verified by a medical coder. For a list of these codes and the body regions affected, contact the Ambulatory and Hospital Care Statistics Branch at ambcare@cdc.gov.

Diagnoses—The six diagnosis groups were classified based on the Barell matrix (see Body regions definition) using the first three listed diagnosis codes, and are defined as: a) sprains, strains, and dislocations; b) fractures; c) contusions and superficial injuries; d) open wounds; e) internal injuries; and f) other and unspecified injuries. For 2016, ICD–10–CM codes were matched to corresponding ICD–9–CM codes and grouped according to the Barell matrix. Certain groups were combined to increase the reliability of estimates. Other and unspecified injuries includes amputations, injuries to blood vessels, crushing injuries, burns, injuries to nerves, unspecified, and injury visits with noninjury codes, which were defined as cases with a diagnosis code that did

not fall in the injury code classification range of ICD–9–CM or ICD–10–CM but were still considered injury visits based on the patient’s reason for visit or cause of injury. For example, a patient visit with the ICD–9–CM diagnosis code of 719.41 “pain in joint in the shoulder region” is not considered an injury based solely on the diagnosis. However, it is classified as an injury visit due to the cause of injury (E-code 886.0 “fall on same level from collision, pushing, or shoving, by or with other person in sports”; and the verbatim cause of injury: “got tackled while playing football”).

Treatments—All diagnostic and screening services that were ordered or provided, procedures that were provided, and medications given in the ED or prescribed at discharge were included.

Imaging service—All imaging services, including computed tomography (CT) scans, magnetic resonance imaging tests, ultrasounds, and x-rays ordered or provided at the ED visit were included.

CT scan—Combines a series of x-ray views taken from many different angles to produce cross-sectional images of the bones and soft tissues inside the body.

X-ray—Includes angiogram and fluoroscopy.

Procedures—All procedures, including cast, splint, or wrap; intravenous (IV) fluids; suturing or stapling as well as other procedures provided at the ED visit were included.

Cast, splint, or wrap—A cast is a rigid or flexible dressing made of plaster or fiberglass, molded to the body while pliable and hardening as it dries to give firm support. A splint is a rigid or flexible appliance used to maintain in position a displaced or moveable part, or to keep in place and protect an injured part. A wrap is an elastic bandage (also known as an ACE bandage, elastic wrap, compression bandage, or crepe bandage) or a stretchable bandage used

to create localized pressure. Elastic bandages are commonly used to treat muscle sprains and strains by reducing the flow of blood to a particular area by the application of even, stable pressure, which can restrict swelling at the place of injury.

IV fluids—Administration of IV fluids.

Suturing or staples—Using stitches, sutures, or staples to hold the skin or tissue together.

Other procedures—All other procedures not listed above.

Medications—All medications that were given in the ED or prescribed at ED discharge were included.

Analgesics—Drugs acting to relieve pain. Based on the Cerner Multum second-level therapeutic category code 58.

Opioid—Subset of analgesics. Based on the Cerner Multum third-level therapeutic category codes for narcotic analgesics (60) and narcotic analgesic combinations (191).

Nonopioid—Subset of analgesics. Based on the Cerner Multum third-level therapeutic category codes for nonsteroidal anti-inflammatory agents (61), salicylates (62), antimigraine agents (193), Cox-2 inhibitors (278), analgesic combinations (63), and miscellaneous analgesics (59).

Antiemetic or antivertigo agents—Drugs used to treat vertigo, nausea, and vomiting. Based on the Cerner Multum second-level therapeutic category code 65.

Antiarrhythmic agents—Drugs used to suppress abnormal rhythms of the heart. Based on the Cerner Multum second-level therapeutic category code 46.

Table. Sports and recreational activity ICD–9–CM and ICD–10–CM codes

Sport or recreational activity	ICD–9–CM code	ICD–10–CM code
Activities involving walking and running	E001	Y93.0
Activities involving water and watercraft	E002	Y93.1
Activities involving snow and ice	E003	Y93.2
Activities involving climbing, rappelling and jumping off	E004	Y93.3
Activities involving dancing and other rhythmic movement	E005	Y93.4
Activities involving other sports and athletics played individually	E006	Y93.5
Activities involving other sports and athletics played as a team or group	E007	Y93.6
Activities involving other specified sports and athletics	E008	Y93.7
Activity involving other cardiorespiratory exercise	E009	Y93.A
Activity involving other muscle strengthening exercises	E010	Y93.B
Pedal cycling	E800.3, E801.3, E802.3, E803.3, E804.3, E805.3, E806.3, E807.3, E810.6, E811.6, E812.6, E813.6, E814.6, E815.6, E816.6, E817.6, E818.6, E819.6, E822.6, E823.6, E824.6, E825.6, E826 (.1,.2,.8,.9)	V10–V19
Nontraffic accident involving motor-driven snow vehicle	E820 (.0,.1,.5,.6,.8,.9)	V86 (.52, .62, .92)
Nontraffic accident involving other off-road motor vehicle	E821 (.0,.1,.5,.6,.8,.9)	V86 (.53,.55,.56,.59,.63,.65,.66,.69,.93,.95,.96,.99)
Animal rider and animal-drawn vehicle accident	E822.5, E823.5, E824.5, E825.5, E827 (.2,.8,.9), E828 (.2,.8,.9)	V80 (.01,.11,.31,.41,.51,.61,.71,.81), V80.2, V80.81, V80.918, V80.919
Accident to watercraft causing submersion	E830 (.0,.1,.3,.4,.5,.8,.9)	V90
Accident to watercraft causing other injury	E831 (.0,.1,.3,.4,.5,.8,.9)	V91
Other accidental submersion or drowning in water transport accident	E832 (.0,.1,.3,.4,.5,.8,.9)	V92
Fall on board watercraft	E833 (.0,.1,.3,.4,.5,.8,.9), E834 (.0,.1,.3,.4,.5,.8,.9), E835 (.0,.1,.3,.4,.5,.8,.9)	V93.3
Machinery accident in water transport	E836 (.0,.1,.3,.4,.5,.8,.9)	V93.6
Explosion, fire, or burning in watercraft	E837 (.0,.1,.3,.4,.5,.8,.9)	V93 (.0,.1,.2)
Other and unspecified water transport accident	E838 (.0,.1,.3,.4,.5,.8,.9)	V94
Accidents occurring in place for recreation and sport	E849.4	Y92.3, Y92.83
Accident from diving or jumping into water	E883.0	W16 (.0,.1,.3,.4,.5,.6,.7,.8,.9), W22.04
Accidental fall from playground equipment	E884.0	W09
Fall from (nonmotorized) scooter	E885.0	V00.14
Fall from roller skates/inline skates	E885.1	V00 (.1,.2), V01 (.01,.11,.91), V02 (.01,.11,.91), V03 (.01,.11,.91), V04 (.01,.11,.91), V05 (.01,.11,.91), V06 (.01,.11,.91)
Fall from skateboard	E885.2	V00.13, V01 (.02,.12,.92), V02 (.02,.12,.92), V03 (.02,.12,.92), V04 (.02,.12,.92), V05 (.02,.12,.92), V06 (.02,.12,.92)
Fall from skis	E885.3	V00.32
Fall from snowboard	E885.4	V00.31
Fall on same level from collision, pushing, or shoving, by or with other person in sports	E886.0	W03
Accident due to changes in air pressure due to diving	E902.2	W94.21
Accidental drowning and submersion while water-skiing	E910.0	Y93.17
Accidental drowning and submersion while engaged in other sport or recreational activity	E910.1, E910.2	W69
Other and unspecified accidental drowning and submersion	E910.8, E910.9	W67, W73, W74
Striking against in sports	E917.0, E917.5	W21
Accident caused by air gun	E922.4	W34.010, W34.110
Accident caused by paintball gun (unintentional)	E922.5	W34.011, W34.111

SOURCES: *International Classification of Diseases, Ninth Revision, Clinical Modification (ICD–9–CM)* and *International Classification of Diseases, 10th Revision, Clinical Modification (ICD–10–CM)*.

**U.S. DEPARTMENT OF
HEALTH & HUMAN SERVICES**

Centers for Disease Control and Prevention
National Center for Health Statistics
3311 Toledo Road, Room 4551, MS P08
Hyattsville, MD 20782-2064

FIRST CLASS MAIL
POSTAGE & FEES PAID
CDC/NCHS
PERMIT NO. G-284

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE, \$300

For more NCHS NHSRs, visit:
<https://www.cdc.gov/nchs/products/nhsr.htm>.



National Health Statistics Reports ■ Number 133 ■ November 15, 2019

Acknowledgments

Special thanks are given to Kellina Phan from the Technical Services Branch of the Division of Health Care Statistics for her guidance and careful review of ICD-9-CM and ICD-10-CM coding classifications. In addition, thanks are given to Brian Ward from the Ambulatory and Hospital Care Statistics Branch of the Division of Health Care Statistics for his critical content review.

Suggested citation

Rui P, Ashman JJ, Akinseye A. Emergency department visits for injuries sustained during sports and recreational activities by patients aged 5-24 years, 2010-2016. National Health Statistics Reports; no 133. Hyattsville, MD: National Center for Health Statistics. 2019.

Copyright information

All material appearing in this report is in the public domain and may be reproduced or copied without permission; citation as to source, however, is appreciated.

National Center for Health Statistics

Jennifer H. Madans, Ph.D., *Acting Director*
Amy M. Branum, Ph.D., *Acting Associate
Director for Science*

Division of Health Care Statistics

Denys T. Lau, Ph.D., *Director*
Alexander Strashny, Ph.D., *Associate Director
for Science*